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Japan

SHALLOW SEA AND INLAND SEA FISH
AND SHELLFISH CULTURAL TECHNIQUES,
PARTICULARLY ARTIFICIAL SEED CULTURE DEVELOPMENT

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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

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SHALLOW SEA AND INLAND SEA FISH AND SHELLFISH CULTURAL TECHNIQUES,
PARTICULARLY ARTIFICIAL SEED CULTURE DEVELOPMENT

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1. Marine aquiculture is one of the most effective methods which utilize the rich productivity of fertile inshore waters. In Japan, commercial culture of various marine species of fish, shellfish, crustaceans, cephalopods and larger algae have been commenced in recent years, in parallel with the general development of conventional types of marine aquiculture. And attempts have still been made to improve the culturing techniques for those species as well as additional species on commercial basis.

2. In this paper, the stage of development of culture technique is indicated for each of the 31 important species of marine animals.

3. The installations that are used for culturing the abovementioned marine animals are classified into 7 types. Each type is described briefly and its advantages and disadvantages are discussed.

4. Some of the practical problems encountered in conducting above conventional types of culture are discussed herein.

I. INTRODUCTION

1. Until recent years, seaweeds such as laver (or Nori), edible oyster and pearl oyster and shellfishes have been the major items, commercially cultured in the shallow inshore seas along the coast of Japan. Commercial culture of marine fishes and crustaceans were also conducted in these waters, but this was done for the purpose of the 'livekeeping' (i.e., keeping the fish alive during the season(s) of low market price) and not for growing the fish, with the exception of a few species.

2. In recent years, there has been quickly growing the commercial culture of those fishes, crustaceans and mollusks which are highly prized by our people, owing to rising prices of these species and to the need on the fishermen's side to compensate for their declining income derivable from

inshore fishing. It should not be overlooked, however, that this rapid growth would not have been possible if the physiology and ecology of these species had not been studied in past years and if such new materials as synthetic fibres, concrete piles, etc. had not been available.

3. In this report the representative methods that are now used in Japan for the commercial culture of marine fishes and shellfishes are described and reference is made to those factors that should be taken into account in constructing marine fish-farms. Methods of seaweed culture are omitted.

II. COMMERCIALLY CULTURED SPECIES

4. Fish, cephalopods, crustaceans and shellfish (both bivalves and gastropods) are the major animal groups that are now commercially cultured in the Japanese inshore waters. The major species are listed in TABLE 1 by these groups.

5. At present, the prawn (Penseus japonica) is the only species that is cultured commercially throughout its life history (i.e. from the artificially fertilized egg through larval stages up to the marketable size). In the other species, commercial culture starts with naturally spawned eggs collected at sea or in the later growth stages.

6. In all the 16 fish species listed in TABLE 1, commercial culture starts with the seedling which are collected at sea and made accustomed to feed on the food given by man; a system of commercial culture starting with artificial fertilization has not yet been practised in any of these fishes. This situation is the outcome of economic considerations in the case of most species, and it is not that the artificial fertilization and/or the rearing of young are technically impossible. Artificial fertilization has been successful, at least experimentally, in most of these fishes, though there is little prospect of the success in the case of the conger eel (Asterococongery myriaster), in which species mature individuals ready for spawning are extremely difficult to obtain. Rearing of the hatched larvae has not been successful, even experimentally, in the fishes with pelagic eggs; in the fishes with adhesive eggs, however, the hatched larvae can be reared without much difficulty. Experimental results suggest that newly hatched larvae of the puffer (Fugu rubripes) and the halfbeak (Hemiramphus sajor) can be reared in quantities up to the size useful as the seedling.

7. The octopus (Octopus vulgaris) is the only cephalopod now commercially cultured, but it is foreseen that the four cuttlefishes listed in TABLE 1 will be commercially cultured in near future, because pilot tests for their commercial culture have been successful. In the commercial culture of these cephalopods, either the seedling captured at sea or the naturally laid eggs (which are collected at sea and incubated artificially) can serve as the starting point. At present, the former is adopted in most cases.

8. The prawn, spiny lobster (Panulirus japonicus) and blue crab (Portunus trituberculatus) are the major crustaceans that are either cultured or 'live-kept' in commercial scale. While the 'live-keeping' of the prawn and its culture starting with the naturally produced seedling have been practised for many years in this country, a method of culturing this crustacean from the artificially fertilized egg through larval stages up to marketable size has recently been established and put into commercial operation. In the blue crab

(Portunus trituberculatus) and spiny lobster (Panulirus japonicus), artificial fertilization has been successful, but the technique of raising the hatched larvae in quantities upto the size of seedling has not been developed. At present, commercial cultures of the latter two species start with the naturally produced seedling captured at sea, and should be regarded as the 'live-keeping' rather than the culture, because the animal does not grow much during the period under confinement.

9. Among the marine shellfishes commercially cultured in Japanese in-shore waters, the seven species listed in TABLE 1 are comparatively important. Artificial fertilization has been successful in all these species, and there are promising indications that their larvae can be raised upto the size of seedlings in quantities. In practice, however, all the species are raised from naturally produced spat, because these spat can be obtained without much difficulty.

III. MAJOR CULTURE METHODS

10. The various culture methods used in the culture of the above-named marine animals fall under one of the following two categories: the "culture in confinement" and the "culture without confinement". The culture methods of the first category are used for those locomotive forms which would disperse unless adequately confined, while the methods of the second category are used for the sedentary forms which, like most shellfishes, show little tendency towards dispersing. Culture methods of each category are described below.

Cultures in confinement

11. The culture methods coming within this category can be classified into the following five types according to the types of installation for confining fish.

- (a) Culture in the floating net: This method has developed primarily for rearing the fish of the size of seedlings but it is recently used for the fish of larger sizes as well. The floating net is a cubic bag or synthetic fiber netting, consisting of four sides and a bottom; it is suspended down from a thick wooden frame which floats on the sea surface and is anchored in place. The size of floating nets is various, and the nets used for culturing fish of marketable size are larger than those used for culturing the seedling. It is foreseen that the use of the floating net will become increasingly popular in raising the fish of marketable size, because the installation is not expensive and is very convenient for taking good care of fish. PLATE I shows an example of the floating net (used for culturing seed-fish).
- (b) Culture in the pound net: This method, commonly known as the "pile method", is used for culturing the fish of marketable size. The pound net is an encircling fence of wire or synthetic fiber netting supported by concrete piles or steel pipes driven into the sea bottom; the fence extends vertically from the sea bottom to a level well above the sea surface, and forms a complete enclosure in plan. Advantages of a pound net are generally good circulation of water and relatively small cost of construction. (PLATE II) (PLATE III).
- (c) Culture in the net-fenced bay: In this method fish are cultured in a small bay the mouth of which is fenced with the wire netting of

fishing net supported by a row of piles; the installation is usually much larger in scale than in the foregoing types. An example of the net-fenced bay is illustrated in PLATE IV.

(d) Culture in the dammed bay: Fish are cultured in a bay the mouth of which is closed with an artificially constructed dike. This dike is provided with one or more water-gates, through which water flows in and out of the bay with tides. This type of installation is rarely built in recent years because of the expensiveness of construction and the difficulty of finding a site with suitable topography.

(e) Culture in the compartment-type cage: This method is used chiefly for culturing the octopus, which is cannibalistic. The cage is made of perforated wooden board or wire screen or combination of both. Its inside is partitioned into a number of compartments, each of which accommodates one individual of octopus, whereby cannibalism is prevented. The cage is securely anchored in a place where the tidal current is strong enough for maintaining good circulation of water through the meshes or netting or through the perforations of the wooden board. At present, the cages used for octopus culture are not very large, usually measuring about 2 x 2 x 1 m with about 120 compartments.

12. Aside from the foregoing types of installation some aquiculturists raise the prawn or the conger eel (Asteroconger myriaster) in sea-water ponds constructed on land. Though this type of pond is comparatively expensive to construct, it has a great advantage that cultured fish can be cared for very well. One of the modernized fish-farms or sea-water pond type, in which the ponds have been built by new techniques and equipped with apparatus for agitation, aeration, etc., is reminiscent of a "fish culture factory".

13. Artificial fertilization, incubation, and rearing of larval stages have so far been carried out chiefly in indoor tanks or in sea-water ponds on land. There is a tendency towards employing rearing tanks of re-circulating type for these purposes, because efficient and convenient re-circulating tanks have been designed recently.

Cultures without confinement

14. The culture methods classified under this category are used for culturing sedentary shellfishes and crustaceans and for seaweed culture.

(a) Raft culture: The representative examples of the raft culture are oyster culture and pearl culture. The animal to be cultured is suspended in water from the raft floating on the sea surface. In oyster culture, the strings of cultch to which oyster spat have settled are suspended from the raft; in pearl culture, pearl oysters are either placed in baskets or attached to strings, and are suspended from the raft. The size of the raft is various, but usually does not exceed 200 m². (PLATE V) (PLATE VI).

(b) Sowing culture: Various bivalves are cultured by this method. The seed, which attach to substrata in some species (e.g., ark shall, etc.) but not in other species (e.g., little-neck clam, hard clam, etc.), are collected in the area where they are abundant, and "sown over the culture bed", that is, transplanted to the area suitable for their subsequent growth. Though primitive, this method has an

advantage in being inexpensive. Those animals which have comparatively small locomotive power and take years to attain marketable size, such as the abalone (Haliotis gigantea), are also cultured by this method.

IV. SOME PRACTICAL PROBLEMS ENCOUNTERED IN MARINE AQUICULTURE

15. In those cultures classified as "cultures in confinement" fish are fed by man, whereas no artificial feeding is involved - cultured animals are left to feed on natural food - in the cultures classified as the "cultures without confinement". In this respect, the two major groups of culture methods fundamentally differ from each other. It sometimes happens, of course, that fish or other marine animals are cultured within an enclosure without artificial feeding, but such a crude method is rarely practised in recent years.

16. Installations for marine aquiculture are located of necessity in the sea or on the sea-shore. Therefore they may be easily attacked by storms, high tides and other natural disasters. It is essential to choose a site that is shown by statistics not to be affected by natural disasters, and to allow each installation sufficient structural strength to endure probable natural attacks.

17. Whatever species may be cultured, it is important that the installation for confining fish allows good exchange of water. Each installation should be of a size that is convenient for taking care of fish, and excessively large installations should be avoided.

18. It is difficult to make any general statement as to the material of food and the method of preparing food, because different species requires different food. It may be safely said, however, that every species needs some amount of fresh meat (i.e., fish meat, shellfish meat or others), and that a cold storage for preserving fresh fish food is needed if a species requiring much fresh meat is to be reared in large quantities.

19. In a culture that starts with natural seedling captured at sea, it is important to sort the seedling according to their size and to rear those of similar size in each enclosure. The use of a fish sorter is recommended in this connection.

20. Different species require different amounts of food. Care should be exerted so that the water of the culturing site may not be contaminated by the decomposition of left-over food.

21. It is noticeable that the optimal density of fish in an enclosure depends not only on the species and size of the fish but also on the structure and dimension of the enclosure. To our regret, standard density of fish has not yet been formulated in most types of marine aquiculture.

22. Success or failure of shellfish culture without confinement largely depends on whether or not the environmental condition of the culture ground is suitable for the cultured species. In choosing a shellfish species to be cultured in a given body of water, one ought to consider, in addition to topography, temperature, salinity, etc., the quality and quantity of natural food available in that water. The author and his colleague have

been selecting suitable species to be cultured in each body of water on the basis of the α - Cl diagram, and this method has been proving successful. In that diagram, α refers to the "suspension factor" and its value reflects the average size of suspended particles, while Cl stands for chlorinity (%).

23. A marine aquiculturist ought to guard against fish diseases and parasites, because these are prone to occur in an intensive fish culture.

TABLE 1. Major cultured species and development in artificial production of their seedling.

Japanese, English & and Scientific name	Culture of		Methods of obtaining	
	marketable size	Culture of	fertilized eggs#	
	Scale	Seedling	Seedling#	Collection:Artificial at sea :fertilization
Hamachi: Yellowtail <u>Seriola quinqueradiata</u>	commercial	natural	commercial	
Bora: Mullet <u>Mugil cephalus</u>	commercial	natural	commercial	
Maanago: Conger eel <u>Astroconger myriaster</u>	commercial	natural	commercial	
Suzuki: Sea bass <u>Lateolabrax japonicus</u>	commercial	natural	commercial	possible
Madai: Sea bream <u>Chrysophrys major</u>	commercial	natural	commercial	possible
Kurodai: Sea bream <u>Mylio macrocephalus</u>	commercial	natural	commercial	possible
Umazurahagi: Trigger fish <u>Navodon modestus</u>	commercial	natural	commercial	possible
Kawahagi: Trigger fish <u>Stephanolepis cirrifer</u>	commercial	natural	commercial	possible
Torafugu: Puffer <u>Fugu rubripes</u>	commercial	natural	commercial	possible possible
Shimaaji: Jack <u>Caranx delicatissimus</u>	commercial	natural	commercial	possible
Kanpachi: Yellowtail <u>Seriola purpurascens</u>	commercial	natural	commercial	possible
Ishidai: Parrot bass <u>Oplegnathus fasciatus</u>	experiment	natural	possible	possible
Ishigakidai: Parrot bass <u>Oplegnathus punctatus</u>	experiment	natural	possible	possible
Tsumuburi: <u>Elagatis bipinnulata</u>	experiment	natural	possible	?
Chidai: Sea bream <u>Erynnis japonica</u>	experiment	natural	possible	possible
Sayori: Halfbrack <u>Hemiramphus sajori</u>	experiment	culture	under study	possible possible
Shiriyakeika: Cuttlefish <u>Sepiella maindroni</u>	experiment	natural	possible	possible
Kaminariika: Cuttlefish <u>Sepia subaculeata</u>	experiment	natural	possible	possible
Koika: Cuttlefish	experiment	natural	possible	possible
		culture		

(Cont'd)

Japanese, English and Scientific name	Culture of marketable size	Culture of seedling#	Methods of obtaining fertilized eggs#
	Scale : Seed- : ling	seedling#	Collection:Artificial : at sea :fertilization
<u>Sepia esculenta</u>			
Aoriika: Cuttlefish	experiment natural	possible	possible
<u>Sepioteuthis lessoniana</u>	culture		
Madako: Octopus	commercial natural	commercial+commercial+under study	
<u>Octopus vulgaris</u>	culture		
Kurumaebi: Prawn	commercial natural	commercial	commercial
<u>Penaeus japonicus</u>	culture		
Iseebi: Spiny lobster	commercial natural	commercial+	
<u>Parulirus japonicus</u>			
Gazami: Blue crab	commercial natural	commercial+	
<u>Portunus trituberculatus</u>			
Mogai: Ark shall	commercial natural	commercial	
<u>Anadara subcrenata</u>	cultured		
Akoyagai: Pearl oyster	commercial natural	commercial	
<u>Pteria martensii</u>	cultured		
Hotategai: Scallop	commercial natural	commercial	
<u>Pecten yessoensis</u>	cultured		
Magaki: Oyster	commercial natural	commercial	
<u>Ostrea gigas</u>	cultured		
Asari: Littleneck clam	commercial natural	commercial	
<u>Venerupis philippinarum</u>			
Hamaguri: Hard clam	commercial natural	commercial	
<u>Meretrix meretrix lusoria</u>			
Awabi: Abalone	commercial natural	commercial	
<u>Haliotis gigantea discus</u>			

* English common name in parentheses.

+ Live-keeping; the growth of fish is not much aimed at.

"Commercial" Commercially practised.

"Possible" Technique established by research, but not yet practised.



Plate I. An example of the floating net



Plate II. An example of the pound net



Plate III. An example of the pound net (Gate)



Plate IV. An example of the net-fenced bay

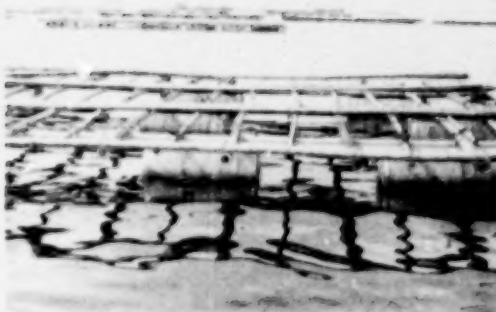


Plate V. An example of the raft (Oyster culture)



Plate VI. An example of the raft
(Oyster seedling culture)



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SUMMARY

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Agenda Item: C.7.1

United States of America

**FORESTRY'S CONTRIBUTION
TO A PERMANENT AGRICULTURE**

By Tom GILL, President,
International Society of Tropical Foresters,
Washington, D.C.

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FORESTRY'S CONTRIBUTION TO A PERMANENT AGRICULTURE

Tom Gill, President
International Society of Tropical Foresters
Washington, D.C.

INTRODUCTION

1. In a world where hunger remains an unsolved problem, and where the need for assured food production becomes more insistent with the passing years, few nations can neglect whatever measures may contribute to a permanently productive agriculture and to adequate living standards for their rural population.
2. The fate of a nation's agriculture is seldom decided in the croplands alone. Factors far removed from the farm may play a major role. Thus the condition and permanence of an agricultural economy may, in very large degree, be governed by the protection afforded to the often-distant upland soils. Erosion, destructive floods, loss of top soil, and water failure may have to be dealt with in establishing a permanent agricultural economy. These age-old enemies are still an ever-present menace to food production, but they can be curbed by a vegetative cover of grass or trees. Grass provides valuable protection against the erosive effects of rain and wind but has the disadvantage of being susceptible to fire and to destruction by grazing animals. Forests are generally the more effective, and throughout history have proven to be staunch allies of agriculture in many diverse ways.
3. In a nation's use of land, forestry and agriculture share the same objective,-- the most efficient management of the soil for human good. Only when the two are seen as interlocking, mutually-sustaining measures can land use be envisaged as a whole, or can the richest returns from agriculture be hoped for. Forestry and agriculture combine to form an essential way of transforming soil fertility into the raw materials man requires. Their techniques and time factors may differ widely, but both agriculture and forestry have to do with growing crops, and both play primary roles in man's dealing with the soil. The very term "farm forest" implies this integration.
4. A planned relationship between agriculture and forestry increases their mutual effectiveness and helps to advance the prosperity of the farmer who, in many countries, is both a forest worker and forest owner.
5. The critical importance of forests to agriculture is still far from recognized by all agricultural planners. As a consequence, thousands of farms have failed to maintain or even reach satisfactory productive standards and thousands of hectares of once-irrigated croplands have been lost to the invading desert.
6. This paper is an effort to point out the intimate relationship that forests bear to a balanced agriculture. It is to suggest how their protective influences may be enhanced and how their economic potential may contribute to the living standards of a nation's rural population. It is directed primarily to countries formulating or expanding their agricultural programs, to the end that forestry may bring to a farm economy the stability that can best come from an integrated use of agricultural and forest soils.

PROTECTION FORESTS

7. Forests serve agriculture in two ways,--as a protection of soils and crops and as a permanent source of many farm essentials. For this reason they have been designated "protection forests" and "production forests" depending on their function, although actually most forests serve both purposes. However, when one objective clearly outweighs the other, forest management is directed toward the major goal.
8. Protection against erosion and destructive waterflow is usually the chief function of the forests in the higher regions where shallow soil and steep slopes make the land unstable. Through the centuries, these forests have attained an equilibrium that enables them to endure and hold the soil in place, but this equilibrium is extremely delicate and any disturbing force--such as fire or widespread cutting--can easily destroy its protective value. Once destroyed, it may never be regained.
9. Where agriculture depends on irrigation, the need to stabilize the upland soil is even more critical. Vast funds have been wasted on the construction of costly irrigation reservoirs and canals which were soon rendered useless by the deposit of silt. The best insurance for permanence of these installations and for a continued supply of water is a forest cover to hold the soil in place, to check the destructive violence of storms, and to conserve every available drop of moisture for use in the croplands below.
10. Forests and Floods: No responsible forester would say that forests can prevent floods. If sustained rainfall is heavy enough, neither trees nor grass nor any vegetative cover can absorb all the water, and in that event floods may result. But forests can absorb vast quantities of water and greatly reduce both flood volume and destructiveness. Peak flows from forested areas rarely exceed 60 second-feet per square mile, while from denuded or eroded land, they often exceed 1,000 feet.
11. A forest cover not only increases the power of the soil to absorb large quantities of water, but it reduces debris and sediment and the vast amounts of silt which augment a flood's volume and violence. It is hard to conceive of the amount of solid material that can be carried by floodwaters rushing down bare or denuded hillsides. Sixty percent or more of the flood's total volume may be composed of solid substances and it is this material which, if deposited on arable lands, can destroy them. Eliminate this, and the destructiveness of the flood will be vastly reduced and its menace to croplands minimized. There is this dual protection, then, which forests provide to agriculture,--reducing the volume of floodwaters and curtailing the accumulation of sediment and debris. From a farmer's standpoint, the deposit of mud and debris may be far more destructive than the water itself.
12. Forests and Farm Water Supply: The effect of trees upon the conservation of water supplies has been too completely documented to need any lengthy discussion. It is well known that waters emerging from forested areas are usually clear and that the flow of water itself tends to be equalized, avoiding both wasteful peak periods and periods of water failure.
13. No matter what tree species compose it, a forest stores a greater amount of precipitation than any other vegetative cover. The litter of leaves, twigs and branches that collect on the forest floor vastly increases the permeability of the soil and allows greater amounts of water to soak in than does a bare earth surface.

This water, sinking into the soil, later takes the form of ground water or becomes the source of springs and is not lost in swift and often-destructive surface flow. Forests, then, increase underground storage water much more than a bare surface or one scantily covered with vegetation. Forests, in a word, tend to maintain a steady flow of water in the streams and to increase the reservoirs of ground water, without which many agricultural communities would find it difficult to endure.

14. Windbreaks and Shelterbelts: Trees are more than protectors of agricultural soil and guardians of agriculture's water supply. From very early times, they have been found effective in shielding crops and farm animals against the hot, drying winds of summer and the freezing gales of winter. Thousands of hectares have been planted to trees for these purely agricultural purposes and such planting usually takes the form of windbreaks or shelterbelts.

15. The broad function of both is the same--protection against the wind. The "windbreaks" usually refers to one, two or three rows of trees whose purpose is the local protection of farm crops from soil movement and the drying effects of wind. Shelter-belts are wider and often of great length and their establishment is ordinarily beyond the resources of the individual farmer and requires the assistance of government. Governmental action and support made possible the thousands of miles of shelterbelts that today protect millions of acres of Russian farmlands. The mile after mile of tree strips in Jutland, without which farming would be impossible, was a governmental enterprise. In Roumania the protection afforded by trees in the farmers' battle against erosion and drought is largely responsible for the continuous production of agricultural crops and for maintaining the living standards of the population. In parts of the United States it is almost useless to grow fruit without windbreaks, and both the quality and quantity of fruits and vegetables have greatly increased when protected by trees. Added to all this are the very tangible benefits of reduced fuel costs and of making the farm homestead more livable, both winter and summer.

16. Establishing windbreaks in agricultural communities is not difficult, but three steps are essential: (1) adequate preparation of the site to be planted; (2) careful planting of hardy tree species, preferably of local origin or proven to be locally successful; and (3) thorough cultivation in the early stages.

PRODUCTION FORESTS

17. Added to the purely protective values of forests is their value as perpetual sources of materials required in an agricultural economy. Here, forests are essential to continuous wood production, and it is here, too, that forestry and agriculture are interdependent economically and are mutually self-sustaining. Work in the woods helps many a farm community financially, and these farm communities in turn create markets for wood industries and provide manpower for logging operations. Work in the forests enables a farmer to utilize his time profitably during seasons of slack agricultural activity and constitutes an important contribution to the stability and standards of rural living.

18. When farm communities have ready access to woodlands, the entire pattern of life is in striking contrast to that of communities living under a chronic regime of wood famine. It is not generally recognized that firewood is one of the world's most important agricultural crops; yet fuel is indispensable, and where wood cannot be obtained, as in the Upper Ganges Plain of India, the farmer is forced to burn cattle dung and agricultural refuse which should go to maintain soil fertility. The time and effort consumed in gathering fuelwood

from distant woodlands represents a staggering loss of agricultural manpower--a loss that could be eliminated by devoting the less fertile, non-agricultural portion of the farm to trees.

19. Wood is not only a spare-time crop. It is a poor-land crop, growing on soils too rugged or too sterile for raising food. Farm woodlands, while still exercising a protective function, may make profitable the use of land a farmer cannot gainfully cultivate for crops. From them he realizes needed products and often a cash income. Fuel, fence posts, material for houses and barns, food for livestock,--all these offer the farmer direct opportunities for cash savings. In times of crop failure, the merchantable material in a farm woodland may prove a welcome buffer against financial disaster.

20. In parts of England, where agricultural work alone, or forest work alone, may not suffice to support a family, planned coordination between forestry and farming has made settlement possible and brought about a stabilized, prosperous existence. Again, in the semi-desert area of southwest India, where land has been placed under irrigation, sections are specifically set aside for forest plantations to meet the woods needs of the farmer.

21. This integration of agriculture and forestry in many parts of the world has brought a stability and abundance to human living that neither agriculture nor forestry alone could achieve. But it does require planning, and often it requires governmental leadership. Certainly, a basic function of government lies in raising the living standards of its people, and in an agricultural community the integrated use of a nation's arable and forest soils is a definite step toward that goal.

DEVELOPING FARM FOREST VALUES

22. In planning an agricultural economy, many nations have found that to include a definite policy for their forest lands helps to insure permanent food-crop production and creates a source of steadily increasing values on their non-arable soils.

23. No country can be said to have a comprehensive land-use policy until it has decided what part its forests and forest soils can play in both agricultural and industrial development. Thus, in seeking a balanced economy, a nation may be faced with the need to convert part of its tree-covered land to agriculture or, on the other hand, to establish tree plantations and increase its forested areas in the interests of soil protection and wood production. In any case, a national policy should direct itself to decisions as to the functions of their forests and forest soils in the major categories of production and protection.

24. Specific requirements will dictate which objective is paramount. In critical areas, the need for soil protection may be so urgent that little or no tree-cutting is advisable. In other situations, the forest may be managed purely to provide the maximum amount of fuel or other wood products. In any case, intelligent planning demands that the lands of a nation be broadly classified as to their suitability for agricultural use and forest use; and, where the forest contains extensive commercial values, that an inventory be made of its contents.

25. Land Classification: In many regions, there exists a profound misconception of what constitutes true agricultural soil, and the world is dotted with abandoned hectares following attempts to force non-agricultural lands to produce permanent food crops. In North and South America, millions of hectares of once-cultivated land have been ruined by erosion because they were not adaptable to agriculture.

In the Philippines any patch of earth capable of producing two or three meager crops is considered agricultural by the "pioneer" farmer, and thousands of hectares have been denuded of forests in misguided attempts to convert the land to agriculture, only to find it unfit for any growth but trees.

26. The fact that an area may support heavy, luxuriant forests but be valueless for food crops is one of the most costly paradoxes in the history of agriculture. These soils appear so abundantly fertile that it is difficult to believe they may be inhospitable to any form of vegetation but trees. Actually, the fertility that sustains the forests lies in the tree itself. The soil is often little more than a foothold for roots and a passageway for nutrients. The fertility derives from the rapid decomposition of leaves and forest litter, returning to the living tree in a kind of closed cycle. When the land is cleared for agriculture, in only a short while the soil is totally unfit for food crops. After brief cultivation, the land is abandoned, the soil having lost what little vitality it once possessed. Some tropical soils are particularly fragile. Once the forest cover is destroyed, the baking sun soon converts the earth's surface to a hard, brick-like substance incapable of supporting even the scantiest vegetation.

27. Farm Forests: In many parts of the world, farm forests comprise the largest area and represent the highest values of a nation's timberlands; yet the average farmer falls far short of bringing to the management of his woodlands the same degree of skill that he brings to his food crops, and when he sells the products of his farm forest, he seldom receives their full value. It is in this dual field of forest management and merchandising that governments can be of practical aid by furnishing the farmer with information and technical assistance. Many countries employ a specialized type of forester known as the "farm forester," trained in the management and the merchandising of farm woodlands. He works directly with the farmer, recommending the proper protective and cutting methods, assisting in selecting trees to be cut, and advising on marketing methods.

28. Forest Research and the Farmer: With a nation's development, the position of the farmer as a forest owner becomes progressively more important. His forests are usually more accessible and occupy more fertile soils than industrial forests, and hence good management yields rich returns. To develop improved practices can be a major objective of any agricultural program where the potential value of farm forests is a significant factor.

29. These improved practices may be arrived at by the slow and often costly road of trial and error, but a far better way lies in research planned directly toward the solution of farm-forest problems and toward increasing their productive and protective values. Pilot tests, for example, can provide the farmer with established facts before he spends time and money on ventures of questionable value. Tests will tell him what tree species are most desirable from the standpoint of survival and rapidity of growth. They will tell him what species are best for special needs.

30. Investigations of this type are usually beyond the financial means of the individual farmer, and it becomes a responsibility of government to assume leadership in this rewarding field. Tests of exotic species that promise to be well-adapted to farm needs, tests of structural characteristics, tests of species most suitable for windbreaks, soil retention and a host of other purposes can best be made by government. In the United States it is a joint Federal-State responsibility to see that the benefits of scientific advancement in forest management and utilization are made available to the small woodland owner. Funds devoted to research of this kind have proven to be among the best investments a government can make in seeking a stable and permanent agriculture.



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SUMMARY

2 Nov.1962

ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: C.7.1

United States of America

FORESTRY'S CONTRIBUTION TO A PERMANENT AGRICULTURE

By Tom GILL, President,
International Society of Tropical Foresters,
Washington, D.C.

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

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FORESTRY'S CONTRIBUTION TO A PERMANENT AGRICULTURE

Tom Gill, President
International Society of Tropical Foresters
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1. Introduction: This paper deals with the multiple ways in which forests are essential to agriculture and outlines measures for increasing their value to rural communities.
2. Agriculture and forestry share the same objective,--the best use of the soil for human good. In practice, food crops generally occupy the more fertile, level soils, while forests occupy the sterile uplands. Yet it is precisely in these uplands--often miles distant--that the fate of agriculture may be decided and where a forest cover may provide vital protection to the arable lands below.
3. Protection Forests: Steep, upland soils are frequently unstable beneath the impact of wind and rain, and when deprived of a plant cover they fill costly reservoirs and irrigation canals with dirt, mud and boulders, ruin farmlands with deposits of stone and silt, and add to the violence of floods.
4. Of all types of protective cover, forests have been found to be the most effective in holding soil in place. They also increase the soil's ability to absorb great quantities of water and so tend to equalize the flow of streams, minimizing both periods of peak water and times of drought.
5. In many countries, trees in the form of windbreaks or shelter-belts have long been utilized by the farmer. They afford protection to crops and farm animals from the hot, drying winds of summer and the gales of winter. Added to this are the very tangible benefits of reduced fuel consumption and greater living comfort in the farm homestead.
6. Production Forests: Properly managed forests are perpetual sources of materials needed on the farm. Fuelwood itself is one of the world's most important agricultural crops. Fence posts, timber for houses and barns, food for livestock,--all these products of the farm woodlands offer direct opportunities for cash savings. Furthermore, wood is a poor-land crop, enabling the farmer to profit from those portions of his land too rugged or too sterile for growing food.
7. Developing Farm-Forest Values: In designing an agricultural economy, intelligent planning demands that lands be used according to their suitability either for food crops, pasture or trees. Failure to do this has brought about severe social dislocations and has dotted the world with barren and eroding hectares--abandoned after futile attempts to force non-agricultural lands to produce permanent food crops.
8. "Farm foresters" have proven particularly helpful in agricultural communities.

These are men trained in the management and merchandising of farm woodlands and are employed by governments or other agencies to work directly with the farmer. Their task is to provide him with information and technical assistance.

9. Since farm forests usually occupy the most accessible and fertile soils, good management yields rich returns and for this reason farmers in many countries have become the foremost timber-land owners. The scientific knowledge that makes good management possible is best arrived at through research. Pilot tests, for example, may determine what tree species are most desirable from the standpoint of survival and rapidity of growth, and what are best for special uses such as wind-breaks, soil retention and fuel.

10. Investigations of this type are beyond the financial means of the individual farmer but funds devoted to such research have proven to be among the best investments a government can make in seeking a stable and permanent agriculture.



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UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: C.5.1

United States of America

ANIMAL HEALTH AND NUTRITION

By William A. HAGAN,
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ANIMAL HEALTH AND NUTRITION by

William A. Hagan

U. S. Department of Agriculture, Ames, Iowa

1. The less developed parts of the world lie, for the most part, in the tropical and subtropical zones. Temperature conditions in these areas are favorable for plant growth. Except for the great deserts in North Africa and southwestern Asia, most of these regions have ample rainfall to support good to luxuriant plant growth. Such vegetation provides food for herbivorous animals, hence the potentiality for producing livestock in these regions is great.

2. This potentiality is realized in only a few relatively small areas. Improved livestock breeds are needed but at present all livestock raising is greatly hampered by widespread destructive diseases and parasites. Domestic animals have difficulty in surviving in many regions and those that do survive often are unthrifty and unproductive. Grains in these regions are seldom used as animal feeds since generally they are needed for direct consumption by the human population.

3. Agriculture is the basic and principal occupation of the vast majority of the people of the less developed areas. The most serious problems of these people are food and health, the former having an important influence on the latter.

4. The potentialities for a better livestock industry are favorable in most of the less developed countries, and their realization would benefit the people of those countries in two ways:

(a) By improving the level of nutrition and thus the health and vigor of the people. The nutritional level of most of the peoples of the less developed countries is poor. Most of them subsist too largely on diets consisting of starches and sugars derived from plants. Protein consumption, generally too low in total, usually consists of vegetable proteins which are deficient in some amino acids, such as threonine, which are essential to human health. The "quality" proteins of animal origin that are found in meat, milk, and eggs, would eliminate this deficiency, improve the general health level, and reduce the infant death rate from "kwashiorkor" which is due to protein starvation, a disease prevalent in many tropical areas.

(b) By improving the economic condition of the people. Foods of animal origin are in demand in all parts of the world. Many tropical and subtropical regions could export large amounts of such foods to other parts of the world if they could control the diseases which now not only limit production but also serve as trade barriers.

5. Animal Disease Control.

The existence in some of the less developed areas (notably Africa) of destructive epizootic animal diseases not adequately controlled poses a threat to the

livestock industries of other countries as well. Thus it should be clear that external assistance in the control and eradication of these diseases will benefit not only the host country but it will also eliminate a continuing hazard to the livestock industries in countries where control or eradication has been accomplished, or where these diseases have never existed.

6. On a world-wide basis, foot and mouth disease is probably the most prevalent infectious disease of animals. Of the great livestock raising continents, only North America and Australia are free from it. The disease is under reasonable restraint in Europe where outbreaks are vigorously combatted. It occurs in all parts of Africa, in most of Asia, and in most of South America. This disease not only hinders the development of cattle and swine industries where it occurs because of its damaging effect on the animals but it restricts export of live animals and fresh food products of animal origin with countries where the disease does not occur because the latter impose embargoes on the importation of animals and animal products that are likely to contain the virus.

7. Rinderpest, which destroys more cattle than any other disease, continues to prevail in many areas of Africa and Asia. Contagious pleuropneumonia of cattle still occurs in parts of Africa, Asia and Australia, whereas it has been stamped out in Europe and North America and apparently has never occurred in South America. African horse sickness and African swine fever are destructive diseases that have long been known in Africa but in recent years have invaded some of the Mediterranean countries of Europe. Two diseases caused by trypanosomes, surra in Asia and nagana in Africa, cause severe losses in cattle, horses, and other species. Piroplasmiasis of cattle and other blood protozoan diseases cause serious losses in many areas. Anthrax prevails in all continents and little is done to control it in many regions. A series of other diseases could be mentioned, particularly from the continent of Africa, but enough has been cited to show that a series of destructive diseases of animals hampers the raising of livestock in the less developed areas of the world and some of them present a direct hazard to the rest of the world.

8. The control of animal diseases in any area or country depends upon:

- (a) the existence of a supply of veterinarians with the requisite technical ability.
- (b) the establishment of an organization charged with the task of controlling and eradicating animal diseases, and
- (c) the enactment of legislation which will adequately finance this organization and provide it with sufficient authority to enable it to do its work without fear or favor.

9. Some of the less developed countries lack the first requirement, hence their deficiency is fundamental and most difficult to correct. When the first requirement can be met reasonably well, the second and third can be met only through determined government efforts. Unfortunately, perhaps partly for financial reasons, there are many countries which meet the first requirement but fail in the second and third.

10. The African Situation.

There is concern that the manifold problems of transition from colonial to national status, the problems implicit in determining priority uses for limited available resources, and in many cases the loss of experienced technical personnel may, in some of the newly independent nations, combine to jeopardize advances already made in bringing the more destructive animal diseases under control.

11. Until recently there has been only one veterinary college (in the Republic

of South Africa) in all of the African continent which lies south of the Sahara desert. This area has a human population of approximately 200 million and a livestock population of perhaps 185 million not including about 5 million camels. Some four years ago the estimated number of qualified veterinarians serving this great area was somewhat fewer than four hundred. In the more advanced nations with human and livestock population of about the same size, but with much smaller land areas, there are more than 20,000 veterinarians, fifty times as many, and the demand for services is still greater than the supply.

12. Because of the decline in numbers of European trained veterinarians and the lack of veterinary schools necessary to train nationals in Central and Western Africa, the governments of these areas are faced with the exceedingly difficult problem of providing the agricultural sectors of the economy with even a reasonable approach to adequate veterinary service. Although figures are not available it is believed that fewer than 100 veterinarians are currently available to serve the large livestock population of that area.

13. Asia and Latin America.

There are about 30 colleges of veterinary medicine operating in Latin America and more than 40 in Asia, not counting those of the Soviet Union. About three-fourths of the Asiatic schools are located either in India (17) or Japan (14). Burma, Ceylon, China, Taiwan, Iran, Korea, Lebanon, Pakistan, Siam, and the Philippine Islands have veterinary schools. The other countries send their technicians to neighboring institutions or to Europe or America for training as veterinarians.

14. What Needs to be Done?

Obviously, a vigorous attack on the epizootic diseases of livestock cannot be carried out without a sufficient staff of well trained veterinarians and a firm policy which will allow governments to marshal their forces and finances to make the attack effective. The financial problems are beyond the scope of this paper but it may be observed that all of the money in the world will not be enough to accomplish the purpose if governmental organization is not adequate to provide the necessary vigor and stability.

15. If enough capable veterinarians are not available for the task that is to be done, foreign veterinarians may be employed to serve in some of the key positions, citizens may be sent abroad for training in the veterinary schools of Europe or America if training nearer at hand is not possible, and finally, if veterinary faculties can be assembled, veterinary schools may be established for training citizens in their countries.

16. The Use of Foreign Veterinarians.

In areas where there are very few veterinarians at present, such as in Central Africa, the most expeditious way to make a beginning on animal disease control is to bring in qualified veterinarians from abroad. Undoubtedly, since there is a world shortage of veterinarians, it will be difficult to recruit such men. Furthermore, there are customs and language problems which militate against their success, and the cost will be great. Such men should be used largely in some of the key positions such as the heads of schools and services. Nationals should be trained by these persons to serve with them and as soon as qualified national technicians are available they should replace their foreign colleagues.

17. The Training of Nationals in Foreign Schools

The training of nationals of the less developed countries that have no veterinary schools is also beset with problems. Students should be selected upon the basis

of ability, previous training and experience, and any other qualifications that mark the individual as suitable for the job to which his training is to fit him. The basic professional training is best given, if facilities are available, in neighboring countries that have similar or identical languages, customs and cultures. If they are to be sent for study to a country where a different language is used they should first be given intensive instruction in that language and required to attain a reasonable proficiency in it before beginning their professional studies. Since the admission requirements of the veterinary schools of the more developed countries are increasingly rigorous it may be necessary to send some students abroad for one or more years' study of the basic sciences before the professional course may be begun.

18. Although most of the veterinary schools of Europe and America are crowded and have more applicants than they can accommodate, many of them undoubtedly would be able to find places for qualified students from the developing countries. The Royal Veterinary College of Copenhagen in 1961 established a special permanent faculty in veterinary medicine for students from the developing countries. Each year five students are accepted. During the first year they learn the Danish language and Danish social, agricultural and cultural traditions. Afterwards they begin their professional studies in the Royal Veterinary College along with the regular Danish students. It is probable that the finding of places in veterinary schools of the more developed countries will not be as difficult as will be the finding of qualified candidates and the means of supporting them during the period of their education.

19. The preceding statements have had to do with the basic training of veterinarians. Another type of training is also needed, that is, post-graduate specialized training of those who will become teachers and leaders of disease control programs in their countries. This does not present as many difficulties as the basic professional training. Less time is needed and there are many places where such training is available. Research institutes and universities in Europe and America are open to such students and actually the number being trained today is considerable although far short of the need.

20. As early as 1920 the Alfort Veterinary School commenced offering special post-graduate courses for young French-speaking veterinarians who were destined for the colonial service. In 1938 a separate school, the "Institut d'Elevage et de Medecine Veterinaire des Pays Tropicaux" began giving instructions to teachers and research workers for foreign service. It has been reported that this institute expects within the next five years to train a supply sufficient to meet the needs of the French-speaking countries that formerly were French colonies.

21. The English-speaking countries have no similar institution; however, special instruction, in English, is given in both Denmark and Sweden for prospective veterinary teachers from the less developed countries.

22. Establishing National Veterinary Schools.

If the need for veterinarians is estimated to amount to 25 or more per year, the country should consider establishing a veterinary school of its own. If the needs are less, it would ordinarily be better for the country to endeavor to interest one or more of its neighbors, preferably having the same or a similar language, in establishing a jointly supported school, that is, a school to serve a region of several countries instead of one. A well equipped and staffed school can train as many as 50 to 60 students per class, hence a single, well supported school of this size can serve a region much better and much more economically than two or more smaller and poorly supported ones. Such a coordinated effort

would also provide for maximum use of all available qualified nationals from the participating countries to staff the positions. It is quite probable that foreign specialists would also be needed initially to provide adequate staffing.

23. Livestock Inspectors.

In countries where field work must be done over wide areas and there are too few veterinarians to do it, persons with lesser training may be used. These are termed variously as livestock inspectors, veterinary assistants, veterinary technicians, etc. These persons may be trained in special schools, or the training can be given by the veterinary faculties. Such persons have been used extensively in Africa, in the Soviet Union, and in some Asiatic countries.

24. These livestock inspectors can be used as quarantine officers, as inspectors of shipped stock, as routine vaccinators, as collectors of blood or other materials for laboratory diagnosis, as artificial inseminators, and so forth. They should be given career opportunities but should not be confused with the professionally trained veterinarians who alone should make diagnoses, and plan and execute disease control and eradication programs.

25. Efforts to begin veterinary training in some of the new nations of Africa have already begun. These should be assisted if help is needed. A veterinary faculty is being established in the new University of East Africa in Kenya, it having grown out of a school previously located at Makerere, Uganda. Discussions are under way on a new college of veterinary medicine to be located at the University College at Ibadan, Western Nigeria with clinical instructions to be given at Vom, Northern Nigeria where a school for veterinary assistants is now operating. There have been discussions also about a new veterinary school at Zaria, at the University of Northern Nigeria, with the clinical instruction being given at Vom, and about a new French-speaking school at Dakar, Senegal.

26. Strengthening of Existing Veterinary Schools and Disease Control Organizations.

In many of the less developed countries there are reasonable numbers of veterinarians but the necessary organization and financial support is deficient. For example, there are 22 veterinary colleges in South America, one in Central America, and four in Mexico. Thus all of the principal livestock raising countries have at least one veterinary school and some have several. The urgent need of these schools is for increased financial support and for more and better trained full time faculty members. At present it is common for these countries to attempt to gain the greatest possible advantage from the limited number of qualified people, resulting in faculties composed of part-time professionals who are also attempting to render full-time service elsewhere.

27. The same observations are applicable to some of the Asian countries, although the part-time faculty system is not usual there. Shortage of schools and veterinarians is not the principal problem in most of Asia. It is the low level of education and the lack of resources among the general population that prevent the efficient operation of disease control services.

Acknowledgement. Liberal use has been made of several documents in the appendix of the Report of the First Meeting of the FAO/WHO Expert Panel on Veterinary Education, Rome, 1962, and of the Animal Health Yearbook published by FAO/WHO/OIE in preparing this paper.

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SUMMARY

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UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
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Agenda Item: C.5.1

United States of America

ANIMAL HEALTH AND NUTRITION

By William A. HAGAN,
U.S. Department of Agriculture,
Ames, Iowa

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ANIMAL HEALTH AND NUTRITION

by

William A. Hagan

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1. In general the less developed areas of the world have climates and rainfall which combine to produce a lush vegetation. Abundant food for herbivorous animals exist but the potentialities for livestock raising is far from realized largely because of the ravages of diseases and parasites. Because of these, livestock are difficult to raise and animals that survive often are unthrifty and unproductive.
2. The raising of more and better livestock would tremendously benefit the peoples of these regions. Human malnutrition is almost universal since most of the people are forced to subsist on a diet consisting largely of starches and sugars with too little protein. Most of the protein is derived from plants and this is generally lacking in some of the amino acids that are necessary for human health and vigor. Meat, milk, and eggs contain the factors that are now missing and are so sorely needed.
3. Reservoirs of a large number of destructive animal diseases are in the less developed regions of the world. The control and elimination of these diseases would not only provide an improved diet and better health for the people of these regions but it would open up export markets for animals and animal products in other areas by removing some of the causes of trade restrictions and embargoes that now exist.
4. Scientific and technical means of controlling most of these diseases are now available. The problem is in finding ways of applying them effectively in the under developed countries. The first requisite is the development of governmental policy to establish adequate veterinary services, the second is to find trained personnel to direct the effort. Generally, adequately trained veterinarians in these regions are too few. In most of the African continent south of the Sahara Desert, excepting the Republic of South Africa, they are almost non-existent. Other areas have a few veterinarians but for financial or other reasons they are not adequately organized and supported to be effective.
5. Improvement in animal disease control in the less developed regions will involve:
 - (a) The employment of qualified veterinary technicians from abroad for training and supervision of control programs, when sufficient nationals are not available.
 - (b) The sending of young citizens of these countries abroad for training and supervision of control programs, when sufficient nationals are not available.
 - (c) The establishment of veterinary schools in these regions, either on a national or on a regional basis. If a country has an annual need for 25 or more veterinarians, it should explore the possibility of forming its own school; if the needs are less, it may be best to pool its resources with its neighbors to develop a regional school.
6. In many instances, all three approaches probably will have to be employed in the beginning. In both Africa and Asia new veterinary colleges are being established which merit assistance.

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UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: C.8.1

United States of America

IMPROVEMENT OF PRODUCTION
AND PRESERVATION METHODS
IN AN UNDERDEVELOPED FISHERY
THROUGH UPGRADING FISHING VESSELS,
GEAR AND SANITARY PROCEDURES

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IMPROVEMENT OF PRODUCTION AND PRESERVATION METHODS IN AN
UNDERDEVELOPED FISHERY THROUGH UPGRADING FISHING VESSELS, GEAR AND
SANITARY PROCEDURES

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Washington, D. C.

INTRODUCTION

1. Acre for acre, the seas are potentially as productive as arable land, but only about one percent of the food consumed by man is derived from the oceans. Estimates place the potential sustained annual yield of the seas at around 500 billion pounds, but only about 16 percent of this potential now is harvested. More important, of the world's harvest of 32 million metric tons of fish in 1958, not over 5 or 6 million metric tons were taken by the less developed nations. While millions of people in such nations suffer the wasting of tissue and the failure of growth associated with the often fatal protein deficiency diseases, just off-shore lie vast resources of animal protein, self-reproducing and almost wholly unexploited.

2. This industrial and nutritional imbalance in the use of the world's fishery resources and in the diets of its people can be redressed. It will require high priority national programs, developed with the assistance of experts, and courageously implemented over a period of years, to provide the skills and supporting facilities necessary to the operation of a sophisticated deep-water fishery. Fishery programs designed to supply either domestic food requirements or the capital necessary for industrialization must visualize the entire fishing industry and its supporting services as a unit. The harvesting of fish, its delivery to port, its processing and ultimate delivery to the consumer, domestic or foreign, must be considered as an integrated system, having one major objective: the feeding of man from a wisely managed, self-reproducing resource. The need for many supporting skills and services, from net-mending, engine repair and vessel construction to processing facilities and distribution systems, must be foreseen. The initial support facilities should be provided at a level of development consistent with the technological awareness of the nation and its contemporary fishing industry. Plans should provide for a systematic upgrading of these skills and facilities as market demands for fish increase in size and complexity.

3. A clear understanding of the relative priorities of the national needs, whether protein food for the domestic population or procurement of capital for industrialization through export of fisheries products, must underlie the national fisheries program. The latter goal is most easily and rapidly reached through contractual agreements with industry representatives of the advanced fishing nations, whereby the entire harvesting, processing and distribution system is planned, developed and operated for the sole purpose of exportation of its products at a profit to industry and to the state. Such systems have been developed

for the new tuna fisheries of Ghana and of the Ivory Coast. This paper, however, concerns itself with the plans of a nation determined to use its off-shore resources primarily as a source of food for its own population and then gradually to achieve export nation status as a natural consequence of this internal growth. The paper will consider a hypothetical, non-industrialized, coastal nation--to which a wide variety of marine resources are available for exploitation. These resources would include demersal (bottom-living) fish, pelagic (surface-swimming) fish and shellfish.

4. The initial level of development of a planned food fish delivery system must be based upon knowledge of the distribution and movements of the fishery resource, on the availability of trained man-power, processing and distribution systems, on consumer demand for the products and on the domestic availability of investment funds. The appropriateness of one or more of the many different types of fishing gear is contingent upon these considerations.

IMPROVED PRODUCTION METHODS

5. Methods that may be considered for improving fish harvest include (1) increasing the efficiency of existing gear by better design and materials, (2) increasing the effective range of craft through incorporating power into vessels, (3) introducing new types of fishing gear which are more effective for harvesting now untapped resources, (4) increasing catch through better fishing tactics, and (5) increasing the number of units employed.

6. In the initial stage of development, let us assume that the nation involved has little more than canoes or other small craft to conduct fishing operations, that capital for investment is small, and that shore facilities for maintenance of larger craft are practically non-existent. In a situation of this sort it is important not to upgrade the methods and craft more rapidly than the other equally important facilities are improved. Thus, simplicity in gear, vessel and deck machinery in the initial stage is important.

7. We would recommend for the first five years of development: (1) That existing gear used to harvest fishes be upgraded through better design and the use of better materials. (2) That fishermen be educated in the best specialized use and tactics for gear with which they are familiar. Employment of a fishing expert familiar with many types of gear would be advisable during this phase, to educate the fishermen in the care and use of these and of the more sophisticated gear to be introduced in the second phase of the program. (3) That all possible efforts be made to increase the number of vessels in the fishery to a point limited only by the demand for their products. (4) That gear for gathering marine animals which remain more or less fixed in their environment, such as oysters, clams, and abalone, be introduced. Simple devices would include shovels, tongs, and rakes. The simple dredge which is effective for harvesting oysters or scallops also could be employed. (5) That the smaller round-haul type nets such as the lampara, purse seine, or ring net, be employed from existing small craft. The lampara nets similar to those used in the California bait catching operations for tuna can be operated from small vessels or open boats and handled manually, and yet they are relatively effective in harvesting the smaller school fishes. Gill nets currently are used in most of the world and represent an effective and simple device for harvesting both fresh-water and marine fish. Some increase in efficiency in this type of gear may be achieved through improvement of materials and use of mesh sizes appropriate to local stocks.

8. In the middle part of the first five-year phase small outboard engines could be introduced. Initially these should be of rugged and simple design to preclude the repeated failures and to eliminate the bulk of the more complicated types.

Fuel tanks, remote starting, remote control, reversible propellers are not necessary for this phase of the program.

9. Within this same period concurrent training in basic skills and services and in the operation and maintenance of larger craft (inboard engines, net-fabrication and principles of navigation and seamanship) should be initiated. The number of fishermen and repair men brought under such training need not be large, but if the program is to be effective, attempts should be made to include talented persons who could pass on their knowledge to their fellow workers.

10. Eventually, as progress is made in processing, marketing and transportation, in development of shore facilities, and as general economic development in the country warrants, the program should be expanded to include more sophisticated fisheries operations. In our hypothetical example exploitation of latent marine resources would require development of craft suitable to operate in offshore waters. Such craft need not be large or complicated, but should be seaworthy, and the engines, the Swedish semi-diesel for example, should be simple and dependable with a minimum of moving parts. The development of inboard small craft which could operate several days at sea would require the additional skills in seamanship, maintenance, and construction. Availability of such craft and skills would be the first step in bringing a large variety of marine resources within reach of the coastal nation.

11. Expansion of fishing out over the continental shelf to exploit demersal and pelagic fishes and shellfishes would require modification of the simple nets used hitherto. The introduction of the specialized net called the otter trawl or of the similar two-boat trawl should be considered in this phase. Trawl nets need not be as large as those used in North Atlantic fisheries; they can be sized to the capacity of the vessels available.

12. In the initial stage utmost simplicity is suggested in deck layouts designed to handle trawl cables and in the types of winches to be employed. Obviously, some trawling in the shallower waters can be accomplished even without the use of winches. The construction of trawls is simple, and although they vary in complexity throughout the world, a common design theme prevails. Use of trawls does not require extensive training, and the skills of local fishermen could quickly be adapted to their use.

13. Further development in the coastal fisheries would be geared to more advanced use of longline gear, both pelagic and ground gear, and to systematic gillnetting or driftnetting in coastal waters. With both types, some mechanization of handling would be desirable but is not essential. The training of fishermen should now be expanded to include visits to foreign areas where operation of craft similar to those being introduced could be observed. This would provide the fishermen with an understanding of the diversification and mechanization possible in fisheries. It would, in the long run, enhance their capabilities to bring about maximum exploitation of their coastal waters.

14. It should not be overlooked that the most effective means of bulk production of pelagic fish has been through the use of purse seines or other round-haul nets. Consequently, during the latter phases of development, the skills, knowledge, and actual use of modern gears of this type must be mastered. The introduction to active fishing with these nets need not be with large complicated gear such as are used in the California tuna seine fisheries. A wide variety of smaller encircling nets is available. The introduction and use of encircling gear will provide the basic training in fishing tactics for the harvesting of schooling fishes such as herring, mackerel, cod, hake, etc.

15. If all phases of the fisheries (production, processing, and distribution) advance in a coordinated manner, and the program achieves some success, then sufficient capital may well have accrued to initiate ocean fishery activities. These would involve large complex craft such as the modern tuna seiner, tuna longliners, or distant-water trawlers. Operation of vessels and gear of this type would require highly developed seamanship and fishing tactics, and skilled operation of vessel machinery, including refrigeration installations. Because ocean fishing involves distant-water operations and considerable knowledge of mechanics and electronic devices, one might expect that expansion into these more complex operations would go beyond the humanitarian aspect of providing protein for the nation involved, to the aspect of providing raw material for export in the world markets.

16. Construction and design of gear probably would not be a major problem, as skills in their operation would have been gained through operating similar units of a smaller size. The advance into the more complex fisheries, however, will require greater assistance from outside technicians than any other phase. This is essentially the period when the local fishermen must master the problems involved in mechanization and the logistics of large vessel operations and when processors must master the most complex problems of world-wide distribution of their products.

17. During this phase the basic vessel design should be given considerable thought, with emphasis on such factors as geographical operating ranges; species to be sought; flexibility of use (multipurpose vessels); refrigeration requirements; and the possibilities of fleet-operated factory vessels. This kind of planning requires a degree of fishing sophistication comparable to that of the advanced fishing nations of the world. The new fisheries, however, need not develop to this degree to be satisfactory. Extremely successful small-boat operations of a local nature may be achieved, and with these, a considerable portion of the protein needs of the nation can be supplied.

IMPROVEMENTS IN PRESERVATION METHODS AND SANITARY PROCEDURES

18. In developing a schedule by which the latent fishery resources of a small coastal nation can best be developed and utilized for the benefit of the people of that nation, it must again be remembered that any increases in the processing and distribution of fish must be coordinated with other aspects of the nation's overall economic improvement effort. If the nation has a wide variety of fish and shellfish available for local exploitation by small boats, the processing problems during the initial five year period may be expected to be associated with maintaining the quality of the fresh fish on the vessel and during delivery to the market place. Two principal factors, time and temperature, are always involved in the spoilage of fresh fish. In the less developed fishing countries of the world, only one of these factors can be controlled practically. This factor is the duration of time the fish are held before being delivered to processors. If both supplies of ice and the facilities to store and use ice on the fishing boats during the initial period are lacking, there is little hope of controlling the second factor by reducing temperature of fresh-caught fish.

19. Sanitation and improvement of quality will require: (1) evisceration of the fish at sea, (2) rinsing of the fish with salt water and (3) the use of wet canvas, spread over the freshly caught fish in the bottom of open boats to protect the fish from the hot drying effects of the sun. It is vital that at first fish should be taken as close to shore as possible so that they can be handled quickly.

20. The lack of adequate marketing and distribution techniques is the basic

obstacle encountered when a fishery has developed sufficiently, through the use of outboards or improved vessels, to supply more fish than is demanded by the consumers in the immediate neighborhood of the fishing port. Retail facilities generally consist of an itinerant peddler, or at best, of a small makeshift store, usually in unsanitary surroundings. Early attention should be given to construction of simple covered structures, consisting of from 80 to 100 stalls. Such structures, costing approximately U. S. \$10,000, would provide retailers, including those handling fishery products, with clean, organized facilities. Each structure should have an adequate water supply, counter space, roof protection, concrete floors and toilet accommodations. Maintenance of sanitation should be enforced through periodic inspections by regulatory officials. Such structures would form the base for a local retail market and for the distribution of the product into the hinterlands. Screened or closed trucks or motor launches, also inspected periodically for sanitation procedures, would serve to transport products from the markets to consumers in the surrounding countryside. As soon as it is technologically feasible, fish must be iced down, both in the market and throughout the distribution system.

21. More complex systems for distribution of fish to increasingly distant markets cannot be accomplished by utilizing strictly fresh fish without refrigeration, as may be done in the seaport area. Therefore, beginning with the sixth year, product preservation through drying, smoking, and salting techniques must be undertaken on a commercial scale in coastal processing plants. The simplest preservation techniques, such as sun drying, should be developed as a commercial enterprise first since they require little or no fuel or chemicals. As fish supplies increase, and the economic situation improves, it will be possible to process fish meal and smoked fish and salted fish for shipment to the hinterlands.

22. Although many of these fish preservation techniques may now be known and in use on a small scale, considerable training and effort will be necessary to adapt them to a commercial processing plant stage. Structures capable of handling several tons of fish per day must be built. Large commercial supplies of fish and salt must be obtained. Practical information about inventory control and sanitation techniques for small plants must be imparted to local workers through training courses in order to step these operations up from the customary family level of effort to the commercial level. To assist in this transformation, it is recommended that technical experts from developed countries be brought in to demonstrate to the local operators the fundamental principles of these processes. This can best be done by constructing demonstration processing plants and employing selected personnel to operate the plants on a training basis under the guidance of the visiting experts. These trainees would be encouraged to apply this knowledge by building and operating similar plants in other regions.

23. As these small plants are established and become productive, and as supplies of fish are increased through the use of more efficient catching equipment such as fishing trawlers, the construction of fish canning and freezing factories should begin. In training of personnel to operate these factories, experts can again be brought in from developed countries and local plant managers can be sent abroad to study existing plant practices. The prospects for foreign investment is great at this stage because of the opportunity for developing profitable export products. But domestic markets, especially for canned fish, should also be vastly improved as local transportation and distribution channels are developed and more people become familiar with the products.

SUMMARY

24. In summary, techniques for the production and preservation of fish in emerging nations must be developed step by step. Introduction of these new techniques will take considerable time since old and established but inefficient catching, processing and marketing methods must be replaced with new and improved methods.

Consideration must first be given to simple improvements such as the increased use of outboard motors and more efficient methods of salting and drying of fish. Later, as other segments of the national economy are improved, additional changes such as the use of motorized trawlers and the construction of fish canning and freezing plants can be considered. At this point, exports of more valuable products such as shrimp and lobsters can provide a significant boost to the economy of the nation.

25. Ideally, the first phase (five years) of a national program for industrial development of the fisheries should include, as a minimum, the following steps:

- (a) Improving existing fishing gear through better design and use of better materials.
- (b) Educating fishermen in best uses and tactics of contemporary fishing gear.
- (c) Training of net-manufacturing and vessel-repair teams and of other supporting services.
- (d) Obtaining, by charter, an exploratory deep-water fishing vessel of advanced design to develop an inventory of domestic marine resources, the ship to be operated by foreign nationals.
- (e) Planning for construction of shore facilities for processing and distribution of products of 2nd phase of fisheries program.
- (f) Training of cadres in outboard motor maintenance and in transom-stern boat construction.
- (g) Educating fishermen in primitive preservation and sanitation techniques for use on existing vessels and products.
- (h) Training of the most promising young men for administration of the 2nd phase fisheries, with the help of fisheries colleges and government laboratories of advanced fishing nations.
- (i) Developing sources of international assistance in financing 2nd phase plant and vessel construction and in procurement of processing and distribution equipment.

26. A general plan as suggested here may provide one key to successful development of a fishing industry. Obviously, the actual course of events of fisheries development in a nation cannot follow any standard pattern, and the technical advisors must adapt their programs to local customs, sources of material, existing economic situations, and even political factors. In any event, the upgrading of fishing techniques should be paralleled by improvements in processing and distribution facilities. The success of such a program would depend on the capacity and quality of the technicians involved and on the national effort expended rather than on the specific suggested scheme of attack.

NOTES

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IMPROVEMENT OF PRODUCTION AND PRESERVATION METHODS IN AN
UNDERDEVELOPED FISHERY THROUGH UPGRADING FISHING VESSELS, GEAR AND
SANITARY PROCEDURES

by

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1. Acre for acre, the world's oceans are potentially as fruitful as arable land but man derives only one percent of his food from the seas. Of the estimated potential annual yield of 500 billion pounds, the present harvest is only 80 billion pounds (1961). More important, less developed nations, as a whole, take only a relatively small percentage of the annual harvest. These countries, badly in need of food protein, have not yet been able to harvest, in significant quantities, the largely unexploited, self-reproducing food resource lying off their shores. This imbalance in the use of the ocean's wealth can be redressed through governmental formulation of national policy favoring the development of a fishery industry and implementation of a rational, coordinated, long-range plan for the systematic improvement and expansion of the existing fishing industry.
2. A workable plan must provide for a balanced, concurrent development of all phases of the industry, including charting of the best fishing grounds and determination of best fishing areas for various species, processing methods which will insure maximum utilization and benefit to the undernourished inhabitants, distribution of the product, and a training program in all these facets. In addition, financial studies should be made to insure mobilization of the necessary capital. Basic to providing protein from the marine environment are the gear and vessels used. Present fishing methods are in accordance with age-old customs and traditions. In a program for the increased production of fisheries products through improvement of fishing methods, the first 5 years would be concerned with improving the catching effectiveness of contemporary gear, instruction in the basic concepts of sanitation, and analysis of present distribution methods.
3. The primitive gear still used, such as pots and handlines, should be improved in design and materials to lengthen their fishing life and make more efficient use possible. Particular attention should be devoted to demonstrations of newly introduced gear and fish handling and processing techniques by experts who would also conduct training classes. This phase would be followed by the introduction of new gear of extremely simple types which could be used for expanding the harvest of the near shore fisheries as well as in fish handling and processing. Examples of these would be the extension of single handlines to longlines which could be used in shallow waters without mechanization, and the use of wet cloth for preserving the catch. During this initial phase every effort would be made to study fishing craft for the purpose of adapting simple, easy to operate out-board motors to these available hulls, and of upgrading the existing fish handling

and processing facilities.

4. Near the end of this 5 year period suitable outboard motors and preservation equipment would be introduced. Coincidentally, a traveling school for outboard and processing mechanics would be established; distribution and marketing clinics would also be established.

5. Based on the experience gained during the first 5 years, developments of the initial part of the second 5 years would be aimed at the introduction of fishing and processing gear for the establishment of offshore fishing operations. These operations would be carried on primarily on offshore banks and would require the introduction of more highly specialized vessels and fishing and processing techniques, including mechanized trolling, gill netting, purse seining, live bait fishing, salting, freezing and canning. In the final phase of the second 5 years, these latter methods would be the ultimate in the development of the fisheries resources as their use would be directed primarily at the harvest, processing and marketing of oceanic fisheries.

It should not be forgotten that in the more advanced areas of the world the mechanization of the fishing fleets has developed over a period of many years. In this developmental program particular attention would be paid to following and adopting the procedures which have been so successful in other areas.



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IMPROVING MANAGEMENT
IN AGRICULTURAL DEVELOPMENT

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IMPROVING MANAGEMENT IN AGRICULTURAL DEVELOPMENT

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1. The rapid improvement in agricultural development requires improvements in the application of human intelligence as well as improvements in machinery, materials and technical methods. In government planning the application of human intelligence is called policy making, and in the regular work of government, administration; in business and farming these responsibilities are divided among management, supervision and labor. The managerial aspects - making and implementing decisions - are important in each case. In a less developed country improvement in management is fully as important as additions to capital and technology. In fact, if policy is to be wise and capital resources are to be used well, improved management is a prerequisite. That is the theme of this paper.

2. The word management is used here to include the responsibilities of all those who are in control of resources and must decide how, when, where and for what purpose they are to be used. In agriculture operating farmers are by far the most numerous managers but the category also includes policy makers, administrators, directors of agricultural research and education, the managers of service institutions and others. Their task is to make the most of the existing situation in a way that builds toward the future. In less developed countries that have initiated progressive programs, improvements in management can bring about new combinations of resources as well as make more effective use of old resources. If management is improved at the various levels, it will be a powerful factor in getting the growth process in motion, one consequence of which will be more agricultural output and income.

3. No attempt will be made in this paper to cover the whole field of agricultural development. Primary attention will be given to problems at the farm level where, in a less developed society, the greatest difficulty is encountered in getting the growth process in motion. The necessary role that added capital and technology must play is not overlooked, but we shall not dwell on it.

Changed Conditions That Affect Development

4. The less developed countries of today face conditions that are sharply different from those of earlier years when some of the now-developed nations were getting their start. Three of these differences seem especially important.

5. One is the phenomenon of national "social awakening". In the past, for example, relatively few people concerned themselves with the over-all process of development. For most people immediate results were what counted. Today, however, many people want to have their say about the process itself. Popular expectations of immediate gains on the one hand, and a well planned and sustained policy of frugality in resource use on the other, are not easily harmonized.

6. A second difference is that almost every country now undertaking economic development finds itself in the midst of a population explosion even before it gets development under way. In earlier times, this was not the case. A less developed country must run fast indeed today, just to hold its own in per-capita income; it must run twice as fast to make any real progress. The rate of population growth will influence policy for the agricultural sector. If growth is rapid, there is little

hope that a less developed nation can move fast enough in its non-farm sector to absorb some of the people employed in agriculture. A country that can use family planning to guide its population growth will have a real advantage. But accomplishing this seems some distance away, even where strenuous educational programs are carried on.

7. A third condition that affects development is the opportunity to export. Most advisers urge less developed countries to expand agriculture partly in the hope of exporting produce to earn more foreign exchange for aiding total development. However, in the present decade, most agricultural export markets are growing slowly if at all. Therefore, if a large number of countries substantially expand their agricultural exports, the price and income drop that would result as larger supplies met an inelastic market demand would bring disaster to one and all. Large increases in agricultural exports is an opportunity for the few, not the many.

Agricultural Planning More Difficult

8. How then can the less developed country best face these and other difficult and complex problems? National economic planning is generally accepted as the proper response. The state must be responsible both for initiating the over-all plan and seeing that it is carried out. India, especially, is demonstrating that such planning can be done without curtailing the democratic political process or personal freedom.

9. Over-all agricultural planning is more difficult to carry out successfully than industrial planning. A variety of approaches is required, depending on the part of agricultural development that is being planned. In particular, there are difficulties in understanding the relation of government to farmers in effective development.

10. It is one thing, for example, for the government to plan for large scale capital investments to expand the agricultural land base. It is quite another to find a way to make the agricultural system increasingly productive at the farm level. An increase in productivity of individual farms does not occur unless there are changed actions on the part of the farmers themselves. Another example is the matter of doing something constructive about the highly variable seasonal farm prices so common in less developed countries. Before harvest, when farmers have little to sell the prices are high, and when the new harvest begins to flow to market the price drops to uneconomic levels. The solution to this problem may involve governmental action as well as the introduction of new approaches by the farmer. Thus it is seen that there are various types of problems and each will require a different approach to have a reasonable chance of being successfully resolved. Yet over-all agricultural planning must harmonize and integrate these several approaches into a single national effort.

11. Those who plan must distinguish between efforts that lift production from one plateau to another and efforts which make for continuous growth. In old, settled countries with a traditional agriculture the level of production depends mainly on natural factors of soil and climate and "the pool of common knowledge" possessed by its farmers. If, to this situation, the government adds large irrigation, drainage or land clearing projects, the effect is to expand the land base but not materially widen or deepen the pool of common knowledge. Production moves up to a new plateau. But a growth process has not been set in motion.

Requirements for an Effective Program

12. The agricultural growth process can get under way only if the forces of change that make use of modern knowledge are brought to bear simultaneously and continuously on all parts of the production process. Since the farmer himself is the central figure in this process (although by no means the only one), the forces of change must be brought to bear on him in a way that will encourage acceptance and use instead of rejection. Massive programs of government action aimed at influencing the farmer frequently fail because, among all the farmers, there is as much build-up in resistance as there is increase in acceptance. The human development aspect of direct governmental efforts often turns sour.

13. In a less developed country with limited agricultural resources the program for change must be concentrated, not diffused through the entire agricultural sector. There seems to be no way to move a country's whole agriculture forward except at a modest pace, but only a rapid pace will set the progressive growth process in motion. Therefore, the effort must be concentrated in selected locations, their number and size depending on the size of the effort that can be organized and implemented.

14. Other rural areas, however, should not be neglected; much that is useful can be done. There is a need for social awakening, and the building of social overhead, and helping people in certain kinds of self-development should be undertaken depending on what seems most logical and what resources are available. Wise planning will see to it that these efforts lead in the direction of agricultural development as much as possible.

What Help From Human Development

15. Everyone knows and accepts the fact that capital and technology make a major contribution to modern production methods whether in agriculture or elsewhere. But what about the contribution of the human factor, especially that of management? Too often, it gets little consideration.

16. The gains from improved management have been studied most widely in connection with farm operators although studies exist for other agricultural fields as well. The farming studies illustrate the point. Wherever a homogeneous group of farms operating under similar conditions are studied, wide differences in output and income are always found even though all the farmers seem to use similar tools and the same amounts of materials and labor. Usually the different results can be attributed mainly to differences in the contribution of the farmer as manager and worker, a conclusion that seems valid.

17. When the causes behind these differences in the margin of output over input are examined, they are found to include some or all of the following:

(a) Differences in the desire to use means to attain specific ends and therefore greater effort on the part of the farmer as manager to gain control over a more effective set of means to obtain the ends in view.

(b) Differences in the effort used to determine what is most important in the immediate tasks at hand so that the manager's limited time and energy can be economized and put to its most productive use.

(c) Differences in the effort put into long term planning. The effective ones bring together more technical and organizational information and analyze it more fully, analyze past accomplishment as a guide to future effort, appraise risks more carefully and integrate the various elements into the final plan more accurately.

(d) Differences in the supervision of the plan in operation with greater attention to the details which really count.

18. These differences in human endeavor which influence the level of output and increase efficiency in resources are, of course, important all through society and not in the farming sector alone. The fact that these abilities can be developed and improved is the important point here.

19. The summing of all conventional inputs in any part of a more developed economy falls by a considerable margin to account for the level of output actually achieved. In the more developed countries, this margin of output over conventional inputs has been widening. The cause for the margin is found in the contribution of the human factor and in the fact that improvements in human abilities are rising faster than inputs of other kinds. It follows that planned improvements in human factor should have more attention.

20. The capabilities of labor are a produced means of production. Education both formal and informal, on-the-job training and health services are important in improving human capability. This is illustrated by the program of education in rural Japan after 1880 which was a key factor in bringing about the outstanding record of growth in agricultural production on a land base that was largely fixed.

21. The process of decision making is at a minimum in any traditional agriculture. For farmers to look for new opportunities, analyze their potential usefulness

and make choices is a new responsibility that must be learned.

22. These ideas are of special importance in less developed countries. Usually the agriculture of such a country is made up of large numbers of small family-operated farms or holdings on each of which much of the output is due to human effort, both in its managerial and labor aspects. A cardinal rule for the optimum development of a less developed economy holds that low cost ways of maximizing the contribution of present resources must be found while scarce resources are allotted to highly complementary uses. In such uses, scarce resources will yield the largest return relative to their cost. In these countries people and therefore human resources are plentiful, and making people themselves more productive will fit the concept of optimizing agricultural development.

23. The remainder of this paper will discuss various problems of organizing and implementing a program intended to bring about rapid changes in farm output and get dynamic growth under way. It applies mainly to countries where farming is largely traditional, where there is pressure of population on land, where opportunities to increase the land base are limited and where a substantial total development program is under way. India's Intensive Agricultural District (Package) Program, essentially of this kind, is putting into practice most of the points discussed here (and some others as well). The human aspects of making such a program effective will have special attention since the more difficult problems arise in dealing with people rather than using improved technology.

An Impact Program

24. The reason for undertaking an impact program in a less developed country is that it is the most promising method of breaking the pattern of slow change typical of a traditional agriculture and of laying a foundation for dynamic growth. This is by no means easy to do; if it were, it would already have been accomplished. Not only must the operating program be carefully designed with this objective in mind, but it must be pressed forward with concentrated, persistent effort. Too often, dramatic results are expected too soon; agriculture does not respond this way. Unless policy makers are prepared to be patient and persistent, they will be wiser not to start.

25. Policy makers should be aware that, even in the best of circumstances; the staff recruited to carry out the program will, at the beginning, be unskilled in many aspects of their job. It could not be otherwise; skill comes with experience and there has been no previous experience of this specific kind. The need for thorough training must be emphasized, although training never substitutes for the learning that comes from working at the job with an open mind.

26. In the selection of areas in which to launch an impact program, those with a generally uniform type of farming will be preferred. In its initial stage this program calls for concentrated effort on a few key problems. Where farming is diverse, problems will be diverse, too, and an impact program more difficult to organize. The area must also be one where substantial increases in production can be achieved without first having to deal with institutional or capital development problems in a major way. If little can be done on production until land reform is carried out or if the area has limited rainfall and a large irrigation project must first be completed, it is not a good candidate for an impact program. On the other hand, there is no merit in choosing a few favorable but unrepresentative areas where solutions will have little usefulness elsewhere.

27. Usually, low yields for major crops will be the common problem that can be dealt with most logically. In what follows the low yield will be used for illustrative purposes in discussing the approach best suited to an impact program. Sometimes an additional problem of a complementary nature can be included; for example, an intensive rat killing campaign might be carried out. Besides killing rats and thus saving grain, the campaign would call the farmer's attention to the fact that a program of action was indeed being started.

28. Farming experts point out that within a single area differences exist in resources, needs and interests among farmers even though the type of farming is similar. This is true and should not be overlooked. But in its initial phase, an

impact program must concentrate its efforts and defer giving much attention to a wider range of problems. They can come later. Making a concerted effort and working on diverse problems can only compete with each other. Key problems must have first priority.

29. The approach to farmers in this regard is crucial. An educational approach has the best chance to succeed since it permits flexibility, respects diversity among farmers, and encourages individual choice-making while centering attention on a specific problem area. A rule-of-thumb approach fails because it ignores diversity and choice and implies a simple and universal prescription for solving farm production problems. Such an approach will be questioned by farmers and will prove to be inadequate in any case.

The "Package of Improved Practices" Approach

30. Where raising yields of the main crops is chosen as the opening phase of the program, those in charge need to be clear about the requirements for success. First, they must know what is involved from the farmer's viewpoint if he turns from traditional practices to progressive ones. The design of the program must help the farmer make this change as smoothly as possible; for him, it is never easy. Second, the situation external to the farmer must be improved so that it encourages him to participate. Third, the various parts of the operating program must be integrated so they reinforce rather than compete with each other.

31. One need is for clear understanding of why crop yields are low. Where this exists the essential biological requirements of the crop are not being met; thus to raise yields, more of the crop's needs must be satisfied. The technical problem is to identify the shortcomings and decide how to correct them; the economic problem is to know whether the changes are profitable; the farm management problem is to know which changes work out best for the farmer; and the program leader's problem is to know whether staff and supplies are such that the job of making the needed changes on many hundreds of farms can be undertaken.

32. We have noted already that the traditional farmer has little technical knowledge, nor is the making of decisions in any specific sense a part of his experience. Under these conditions, the use of the "Package of improved production practices" idea is a simple yet effective approach. It requires, first, that specialists develop a simple package of improved practices for each important crop. These practices must be well adapted to the area so many farmers can use them, must give dependable and profitable increases in yields and be of the kind that typical farmers can adopt successfully.

33. Within an impact area, the package of practices should be varied by the specialists to fit local conditions. However, it is not intended to be an optimum set of practices for any one individual but rather a generally dependable set that hundreds of farmers can adopt and get a substantial increase in yield. More progressive farmers may make a more skillful application of the package or even modify it out of fuller knowledge to fit their situation more accurately. But they will be the exception - the main program must center on the recommended package.

34. The program leaders should recognize that this idea will not fit every situation. There will be some farms where the practices will not give a dependable response; these should not be included. In an impact program, it will not likely be possible to cater to special needs at this stage.

The Off-The-Farm Phase

35. The point was made earlier that conditions external to the farm must be favorable if the farmer is to be successful with his part. So the necessary off-the-farm part of the impact program must be effectively organized to make sure that the favorable conditions are a reality. The essentials are three: First, to assure that the supplies called for by the package of practices are available where the farmer can get them and in ample time prior to planting his crops. Second, to see that the credit needed to finance the supplies and other production needs is available in a way that is satisfactory to the farmer. (This includes his being able to get the

credit well in advance of seasonal needs; moreover, the credit rules must fit the smaller as well as the larger farmer.) Third, to see that the size of the program being undertaken is consistent with the size and quality of staff available to carry it out. If too much is attempted, the whole project may fail. Through carefully planned, intensive training, the available staff can be helped to rise above its usual level of accomplishment.

The Simple Farm Production Plan

36. A crucial matter is to select an effective way of working with the individual farmer. The use of a simple farm production plan is the most effective way known for helping a traditional farmer to make a successful break with the past and to enlarge the break once it has been started. It succeeds because, properly conceived, it fits the farmer's natural way of thinking and doing. The process it uses is consistent with the way farmers go about making changes; therefore, it is not alien to them. Since the details of this idea are new, we shall go into them at some length.

37. This simple farm planning process has quite different purposes from the farm planning work of more developed countries although the broad objectives are similar. Its basic approach is to assure the traditionally minded farmer that he can better himself by making a simple change that is within his means. It begins by bringing to him through field demonstrations of the improved crop practices a picture of the yield increase that is readily possible on his own farm. It enlarges on this idea through village meetings and personal discussions. It identifies this improvement with his desire for a larger and better food supply for his family, with reduced hazards from weather and with increased marketings and more income from the crops he ordinarily sells.

38. The extension worker offers him a specific opportunity in a package of improved practices for his main crops. He helps him see how these fit his conditions; he clarifies the steps involved in using them. He sets before him a simple choice, the better way and his old way, and helps him make a positive decision. He does not push the farmer further than he is willing to go but encourages him to take a substantial step forward. The idea gains support because every participating farmer in his village and in the whole impact area is taking the same kind of step forward. Traditional farmers need the security that comes from doing what their fellow farmers do. Moreover, the farm plan provides a link between the farmer and the extension worker, something seldom found in a less developed country, a link that can build increased confidence in the soundness of modern farming over time.

39. The farm planning pro forma should be designed to help the farmer with his decision making; it must be brief and logical. Basically, it consists of two parts, a "situation" section and a new farm plan. The situation section lists information about the farm, the farmer and his family, his operating resources, the crops he has been growing and their production, the practices he has been using, special problems peculiar to his farm. Two pages should suffice. The new farm plan has five brief parts: First, an educational section to provide a review of the package of practices, including the additional gain and added costs from using the package under his own conditions. Next, a place for setting down his crop plan for the new year and the production expected; it must reflect what the farmer is willing to do. If he chooses to apply the practices on part rather than all his acreage, the plan will show this. Third, a buying list of the supplies he will need. Fourth, an identification of the credit needed to finance the plan - amount, source and how it will be repaid. Lastly, a brief summary of what he will have to sell and the expenses he has to meet. If livestock or other sources of income are important, a place will be found for this. Four pages for the new plan should do.

40. The farmer will need a copy of his plan, perhaps in simplified form, whether he can read it or not. It will give him a feeling that he is doing something important. One copy will be needed for obtaining the credit and supplies; later it will be kept by the extension worker as a guide in counselling the farmer.

41. This farm planning idea, being progressive in concept, picks up each new

season where it left off the last one. It will help each farmer to identify his successful accomplishments, review shortcomings and their causes, consider new opportunities and fit those selected to his improving situation. Being flexible, farm planning can advance as rapidly as the farmer masters each step of progress. Later on, as the program advances, it can incorporate more advanced practices, consider a better selection of crops or consider new enterprises.

42. The program will gain in breadth and depth of knowledge about farming if a record of performance (farm record) is obtained from representative farmers on the various sizes of farms. Such farm records will provide needed factual results from farming operations for strengthening the farm planning work as well as be useful to administrators and policy makers as indications of what is being accomplished.

About The Small Farm

43. Since less developed countries contain many small farms, let us ask how the small farm might be related to this program. For purposes here, the class of small farm will include those whose economic viability is being questioned in a less developed country. Although some countries try to define this in terms of acreage, obviously the definition is not satisfactory; land varies greatly in the type of crops for which it is suitable and in the yields secured. On the whole, small farms can be placed in three broad categories:

44. (a) One group, probably the largest, includes those farms which will prove to be economically viable once their farming is made modern and up-to-date. Yields can often be doubled or more in a reasonable length of time and more intensity of other kinds can be introduced. In this group, the fault is not so much that the farms are small as that neither the farm nor the farmer is productive under prevailing conditions. The solution is to help them become productive by devising a program that fits their needs. The program already discussed is basically useful although some special adjustments likely will be needed.

45. (b) A second group includes farms and farmers that otherwise might fall in group one but are suffering from some disability which the farmer cannot remove through his own efforts. There is a wide range of these. Examples include: the farm family in poor health; the farmer of low mentality; farms where the produce must be divided with a landlord (small farms can hardly succeed except under full ownership); farms that lack needed irrigation, drainage or soil conservation which can only be provided through large projects; farms located in areas of acute social unrest. The solutions of some of these problems is reasonably within the means of government in a less developed country; others are not. Some are clearly welfare cases. The program discussed above is not appropriate for these farmers.

46. (c) The residual group includes the tiny farms which, even in the most favorable situation, will not support a family in an acceptable manner. Where dependable off-farm employment is available, these farms can provide family homes where part of the family food supply can be produced. In the present state of non-farm development in most less developed countries, not many such farmers can find dependable off-farm jobs. If not, basically they are welfare cases.

47. Before a logical small farm program can be undertaken a careful, informed, unprejudiced analysis must be made of the situation. To say that all small farms are economically not viable is patently erroneous; to say that all can be made viable with adequate programs is equally in error. Nor, at the stage before modern productive methods are brought in and both the farm people and the land given opportunity to develop, is it easy to tell which farmers and farms will prove to be viable and which ones not. But this is no reason for not setting forth to find out and set policy accordingly.



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FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: C.1.4

United States of America

IMPROVING MANAGEMENT IN AGRICULTURAL DEVELOPMENT

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Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

NOTES

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IMPROVING MANAGEMENT IN AGRICULTURAL DEVELOPMENT

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1. In a less developed country, rapid improvements in agriculture requires improvements in human abilities as well, as in technology, institutions and organization. The development process brings in additional resources; these permit more productive combinations of new and old. To assure that these are the best possible, improvements in managerial skills are needed by policy makers, administrators, directors of agricultural research, extension and teaching, operating farmers and others.. Human improvement is a vital matter.
2. To be effective, managers must take account of prevailing conditions in the country, three of which have changed significantly since earlier days of economic development. One is that a great many people now expect to have a say in deciding what should be done. This is good. However, many will not have the knowledge needed for guiding the development process itself and may lend an adverse influence. Frequently they want results too quickly when, in fact, continued frugality and sustained effort are essential for getting dynamic growth in motion. Another is that the population explosion has come before development is well started. For agriculture, this will keep people on farms and prevent the gains that come from increasing the size of small farms. It also makes it difficult to raise productivity and income of landless workers. A third is that the present slow rate of growth in agricultural export markets limits the expansion in production that might be undertaken to earn foreign exchange.
3. Most countries are using national planning to deal with these and other problems, a move that requires managerial skill on the part of planners. India is proving that national planning and political freedom can be harmonized. But planning for agricultural development is difficult, especially in finding an effective way for government to help farmers become more productive. Massive government programs with this objective have failed more often than not. A key matter is for planners to understand the process by which farming becomes more productive as contrasted with that of industry. With farming, the present farms and farmers must produce the additional output whereas it is mainly the additional factories that produce the larger industrial output. In less developed countries, most farmers are traditional and conservative in outlook; large increases in output from their farms is not easy to bring about.
4. If production per farm is to be substantially increased, the forces of change must be brought to bear simultaneously and continually on all parts of the agricultural sector including large numbers of farmers. However, if the country's whole agriculture is treated as a unit, the limited supply of skilled helpers and technical resources for implementing the change will spread too thinly and little will be accomplished. Concentration in selected areas is essential if a break with the past is to be made; these should be favorable areas for such an effort.

5. A prerequisite to success with farmers is that the surrounding conditions must support the effort: a favorable economic climate; adequate technical supplies; a usable credit system that fits the needs of smaller farmers as well as larger one; effective research to develop output-increasing possibilities; extension to help farmers make the needed changes; administrative organization that fits the special needs of agricultural development, something different from the usual system. Human ability plays a larger part in production than is generally realized, thus growth in understanding is a prerequisite to the effective use of improved production methods.

6. It will be difficult to bring about a break with the past in the selected farming area, so a sustained impact program is needed, one that centers on a few key matters in its opening phase. It should develop a simple, dependable and profitable "package of improved production practices" for the main crops suitable for hundreds of farmers to use - a job for specialists; these to be offered to all farmers who can use them. The farmer should not be asked to make changes in his cropping system until he has mastered the yield-increasing practices. A thorough and continuous educational program with emphasis on well planned demonstrations of the improved practices is required to convince each farmer that they will fit his own situation. Then, through the use of a new kind of simple farm production plan, the farmer will be shown the advantage to him of adopting the practices as a package thus calling for a single decision - choosing between the new way and his usual way. The extension worker helps him see that many other farmers are taking the same step forward; the traditional farmer wants assurance that the new idea has general acceptance.

7. When large numbers of farmers make this first important step forward, the total output and income increasing effect will be clearly noticeable and pave the way for further progress. The simple farm plan calls for an annual review of progress and new possibilities with each farmer, thus is a powerful and progressive tool for improving the productivity of the farmer as well as the farm. It is only as farmers, themselves, grow in management ability that they find ways to make their land and other resources increasingly productive, a necessity where the farm land is already occupied.

8. Small farms frequently pose a special problem. Careful examination usually shows that large numbers of them can become economically viable if the process discussed above of making the farmer productive is applied to the small farmer, too. Given a program designed for his needs, usually this can be accomplished. There will be cases, however, which suffer from disabilities that the farmer, himself, cannot remove. Some will respond to treatment, others not. Finally, some farms are such tiny economic units that the farmer must be considered a welfare case unless dependable off-farm employment is available to provide the main source of income.

9. In the end, the agriculture of the less developed country will make progress in keeping with the development of its people.

